Event Report
CMEC – Maritime Knowledge Lecture '*CEZ Development, Biomanufacturing and Circular Bioeconomy'*

Organised by CMEC at RIS and FISD in collaboration with DBT

| 25th March 2026 | IHC, New Delhi

The Centre for Maritime Economy and Connectivity (CMEC) and Forum for Indian Science Diplomacy (FISD) at RIS, organised thw session of the 15th Maritime Knowledge Lecture Series on *"CEZ Development, Biomanufacturing and Circular Bioeconomy,* with the Knowledge support from Department of Bio-Technology, Government of India. The lecture formed part of ongoing effort by CMEC at RIS, to bring together policymakers, scientists, and industry stakeholders to deliberate on emerging dimensions of India's maritime and blue economy.

Anchored in the broader framework of **Maritime Amritkal Vision 2047**, the session examined the role of biomanufacturing and circular bioeconomy in shaping the next phase of coastal industrial development. With India's coastline extending over **11,098 kilometres**, and Coastal Economic Zones (CEZs) being developed under the **Sagarmala Programme of the Ministry of Ports, Shipping and Waterways (MoPSW)**, the discussion highlighted the opportunity to leverage marine bioresources for sustainable and high-value economic activity.

Panel:

I. Dr Debasis Dash, Director, Institute of Life Sciences (ILS) – Lead Speaker

II. Dr Shishir Shrotriya, CMEC – Moderator
III. Dr Rajkumar Halder, Founder & CEO, Ruhvenile Biomedical – Industry Panellist
IV. Dr Vaishali Panjabi, Associate Head (Biomanufacturing), Department of Biotechnology, Government of India - Panellist
V. Dr Amit Kumar, Forum for Indian Science Diplomacy, RIS - Panellist

Setting the Context

The session was introduced by Dr. Shishir Shrotriya, CMEC who placed the discussion within the evolving policy landscape of India's maritime sector. He emphasized that while programmes such as Sagarmala have laid the foundation for port-led industrialization, the next phase of growth must be driven by **technology integration, value addition** and sustainable use of resources.

He highlighted that Coastal Economic Zones beno longer to be viewed merely as industrial corridors, but as **integrated ecosystems** that combine manufacturing, logistics, innovation, and resource based industries. In this context, biomanufacturing and marine clusters, emerge as a critical enabler for unlocking the full potential of the blue economy.

Biomanufacturing and the Blue Economy Framework

Dr. Vaishali Panjabi outlined the Government of India's approach to advancing biomanufacturing under the BioE3 policy framework, which integrates the objectives of **Economy, Environment, and Employment**. She emphasized a shift in perspective from viewing oceans as passive ecological systems to recognising them as dynamic bioresource reservoirs capable of generating fuels, chemicals, and high-value products.

She highlighted ongoing efforts to establish bio-foundries, biomanufacturing hubs, and integrated biorefineries, which are expected to enable the scaling of bio-based products, including those derived from marine systems. Particular emphasis was placed on the potential of marine biomass and coastal waste streams to be converted into biofuels, bioplastics, and biofertilizers, thereby aligning economic development with environmental sustainability.

The integration of carbon capture with marine biomanufacturing was also identified as a key opportunity to create closed-loop production systems, particularly in coastal industrial clusters.

Scientific Foundations of Marine Biomanufacturing

Delivering the lead lecture, Dr Debasis Dash provided a comprehensive scientific perspective on marine biomanufacturing and circular bioeconomy systems. He emphasized that oceans remain one of the least exploited bioresource domains, despite their immense potential.

The discussion focused on three key resource streams, seaweed (macroalgae), microalgae, and coastal organic waste, which can serve as feedstock for bio-based industries. Dr Dash elaborated on the concept of a circular bioeconomy, highlighting the need for zero-waste, multi-

product extraction systems, wherein biomass is processed into multiple value streams such as lipids, proteins, polysaccharides, and biofuels.

Drawing on ongoing research at the Institute of Life Sciences and partner institutions, he presented findings on:

- Marine microbial isolation and genomic characterization
- Identification of industrial enzymes with commercial potential
- Development of probiotic applications for aquaculture

A significant insight from the lecture was the scale of import dependence on industrial enzymes and biochemicals, which presents an opportunity for domestic production and import substitution. He elaborated on the Government's initiatives for advanced test equipment sharing through **SAHAJ and** the digital intelligence platform **Sujvika**, that provides structured and verified data about biotechnology product imports into India. The platform also provides, support to indigenise, high value and high volume bio-tech products, required to be substituted indigenously.

Dr. Dash also highlighted critical challenges, which include the absence of clear regulatory frameworks—particularly in relation to sea leasing for marine cultivation, fragmented institutional responsibilities, and inefficiencies in biomass aggregation and processing. He emphasized that transporting raw biomass across long distances is economically unviable, necessitating localized processing systems within coastal regions, near ports. He also promoted the need for mechanised seaweed farming through sea-leasing schemes.

Industry Perspective: From Innovation to Commercialisation

Dr Rajkumar Halder brought a biotechnology entrepreneur's perspective, highlighting the practical challenges of translating scientific innovation into market-ready products. Drawing from his experience at Ruhvenile Biomedical, he emphasized that while India has strong research capabilities, the ecosystem for scaling innovation remains underdeveloped.

He noted that the transition from Technology Readiness Level (TRL) 7 to commercialization represents a major bottleneck. This stage is often constrained by limited access to capital, regulatory uncertainties, and the absence of reliable supply chains for raw materials.

Through examples of products developed using bio-based and marine-derived inputs, Dr Halder demonstrated the viability of indigenous innovation. At the same time, he emphasized the need to build confidence in domestic technologies, strengthen validation mechanisms, and create enabling conditions for startups to scale.

He also underscored the importance of reducing dependence on imported inputs, particularly in critical biochemical segments, and promoting self-reliance through ecosystem development.

Emerging Technologies and Global Competitiveness

Dr. Amit Kumar provided a forward-looking perspective on the evolving global landscape of biomanufacturing. He emphasized that technologies such as synthetic biology and artificial intelligence are rapidly transforming the sector by enabling the design and production of biological systems with greater precision and efficiency.

Drawing on global developments, he noted that leading economies are already integrating computational tools with biological sciences to accelerate innovation. In this context, he cautioned that India must adopt a more accelerated and proactive approach to technology adoption to remain competitive.

He highlighted the need for interdisciplinary convergence, integrating biological sciences with digital and engineering capabilities. Increased investment, institutional coordination, and strategic prioritization of emerging technologies were identified as key to positioning India in next-generation biomanufacturing.

Key Takeaways and Way Forward

The discussions during the session converged around several key priorities for advancing biomanufacturing within CEZs.

I. **Need for a coherent regulatory framework:** There is a clear requirement for a well-defined regulatory structure governing marine resource utilization. The absence of standardized policies, particularly with respect to sea leasing, creates uncertainty and delays implementation. A streamlined approval mechanism, along with improved inter-ministerial coordination, is essential.

II. **Decentralized biomass processing within CEZs:** Given the dispersed nature of marine biomass, the development of localized processing systems is critical. Decentralized biomass aggregation and processing within CEZs will enhance economic viability and support circular bioeconomy models.

III. **Strengthening research-to-commercialization pathways:** Bridging the gap between research and market deployment remains a priority. Strengthening the transition from Technology Readiness Level (TRL) 7–9 through targeted funding, pilot facilities, and industry partnerships will be crucial for scaling innovation.

IV. **Promoting domestic production and reducing import dependence:** The session underscored the importance of building domestic capabilities in enzymes and biochemicals. Reducing reliance on imports presents both a strategic necessity and a significant economic opportunity.

V. **Adoption of advanced biomanufacturing technologies:** There is a need to accelerate the adoption of next-generation technologies, including synthetic biology and artificial intelligence. This will require greater investment and the promotion of interdisciplinary research ecosystems.

Conclusion

The session underscored that biomanufacturing and circular bioeconomy are integral to the next phase of CEZ development and India's broader maritime strategy. By bringing together insights from science, policy, and industry, the lecture highlighted both the opportunities and structural challenges in building a robust marine bioeconomy. The event discussed the finer aspects of 'Lab to Market' implementation and 'Whole of Government' approach.

The discussion reaffirmed that achieving the objectives of Maritime Amritkal Vision 2047 will require a coordinated, technology-driven, and ecosystem-based approach, positioning Coastal Economic Zones as hubs of sustainable and innovation-led growth by driving Marine Clusters.